

Re-engineering Engineering Education

Today's graduates do not have the broad background necessary to understand, take charge of and drive large-scale projects

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In 2005, leaders gathered by the National Association of Manufacturers declared yet another "STEM" emergency. In the face of global competition, they argued, the number of bachelor's degrees awarded annually to U.S. students in science, math and engineering must double by 2015.

In fact, the need for STEM talent is even more critical today as the nation claws its way back from a deep recession. Furthermore, reports such as *Rising Above the Gathering Storm* (National Academies Press, 2005), indicate that the U.S. is in danger of losing its historic preeminence in creating and manufacturing advanced products due specifically to problems with *engineering education*—a critical subset within the STEM world. The problems facing engineering education, the report suggests, go beyond a need to simply educate more students or raise performance on exams. Instead, when it comes to engineering, what is even more critical than quantity is *quality*. Too often, U.S. engineering is not cost-effective because the majority of today's engineering graduates do not have the broad background necessary to understand, take charge of and drive large-scale projects to completion in an economic fashion. [See "Engineering Education Must Get Real," Bernard M. Gordon, *THE NEW ENGLAND JOURNAL OF HIGHER EDUCATION*, Summer 2007.]

A Fresh Start at Northeastern

Within the region, progress is being made through initiatives of the Gordon Foundation, with an established engineering leadership program in place at Tufts University, enhancements to the engineering program at Worcester Polytechnic Institute and new engineering leadership programs at both MIT and Northeastern University.

The Gordon Engineering Leadership Program at Northeastern, launched in fall 2007, aims to ensure that engineering leaders develop the *mindset* required to assume full responsibility for their success and the success of their organizations. The program's first group of graduates emerged in summer 2008, and a second cohort is close to completing the program.

Borrowing a concept from the medical profession, the notion pursued at Northeastern is that an equivalent of the doctor's internship year is vital for bringing the

theoretical and academic achievement of the prospective engineer into practical alignment with the needs and necessities of the real world and into fuller engagement with the individual's sense of self and sense of purpose.

To reinforce the real-world nature of learning, each student admitted into the program must be sponsored either by industry, a government agency or through Northeastern's Center for Subsurface Sensing and Imaging Systems. Each student conducts a challenge project on behalf of his or her sponsor. As in a medical internship, the experience requires not only the successful application of engineering knowledge but also development of the commitment required to deliver results and overcome difficulties that manifest themselves on both a personal and technical level.

Those who complete the program not only earn a master's degree in a core engineering discipline, but also acquire a deeper understanding of "Engineering Leadership" and the ability to do rapid, back-of-the-envelope technology trade-off analyses. In short, they have begun to hone their engineering instincts.

Matthew Dickman, who received his bachelor's degree in Electrical Engineering from Northeastern in 2007, went to work for NeuroLogica Corp. in Danvers, Mass., a medical imaging company. In fall 2007, he entered the

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Gordon leadership program where his challenge project focused on improving computed tomography images. He received a graduate certificate in Engineering Leadership and a master's in Electrical and Computer Engineering Leadership from Northeastern in August 2008. Now back as a manager at NeuroLogica, one of Dickman's key roles is working with medical organizations to develop new products.

"In my first work experience as a co-op, I looked to other knowledge holders to help me analyze engineering challenges," explains Dickman. Since completing the program, however, Dickman says he feels empowered and encouraged. "If I'm facing a challenge, I will rely on

my own coursework and knowledge to identify a solution," he says. What's more, he has taken on more of a "big picture" perspective. He recently incorporated material properties coursework to develop a radiolucent neuro-surgical cranial-fixation system that surgeons now use to take intraoperative CT scans directly in the operating room. "This gives the surgeons confidence that their procedure is complete and, in my opinion, provides a better level of care for the patients," says Dickman.

Another example is Anthony Serino, a 2007 graduate of Northeastern, who earned a bachelor's in Electrical Engineering and Computer Engineering, then went on to receive the graduate certificate and master's. He is currently employed by Raytheon Integrated Defense Systems in Tewksbury, Mass., as a systems engineer where he focuses on signal, video and image processing, algorithm development and optimization, coding and systems engineering. Through the Gordon program, Serino conducted an independent challenge project to develop a multimodal explosives-detection system that would provide reliable explosive material detection at safe ranges.

Raytheon, which has sent eight students to the Gordon program, is pleased. "We see the returning employees better prepared to work in industry because they come

up to speed quickly in the industrial setting and, with their breadth and depth of technical knowledge, they can contribute to and lead teams to develop technology and integrate it to solve problems," says Mark Russell, corporate vice president for Engineering, Technology & Mission Assurance at Raytheon. Other organizations sponsoring students have included Analogic Corp., Analog Devices, the U.S. Army Night Vision and Electronic Sensors Directorate, Textron Systems, IMI and the U.S. Air Force Research Labs.

Solving STEM challenges in general goes beyond the scope or ambition of the Gordon program at Northeastern. As one observer has noted, there are many *Paul Reveres* raising the alarm on the subject. However, we hope the Gordon Engineering Leadership Program will show how academic excellence can be more effectively linked to practical, real-world capabilities.

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